Pulsed Electromagnetic Field Stimulation on Closed Tibial Rats Fracture Enhances Callus Formation Based on Radiographic Measurement

Rizmayadi Anwar, Nucki Nursjamsi Hidajat, Bambang Tiksnadi , Hermawan Nagar Rasyid

Departement of Orthopaedic and Traumatology
Faculty of Medicine, Universitas Padjadjaran /Hasan Sadikin Hospital, Bandung

ABSTRACT

Introduction. Complication of delayed union and nonunion is the most common problems found in the Tibia fracture, especially tibia fracture with intact fibula who risk for delayed union and nonunion. Previous studies have been conducted primarily for the augmentation of fracture healing by enhancing callus formation, among others, with internal and external stimulation. Whereas with external stimulation such as pulsed electromagnetic field (PEMF) which the inductive coupling of a non invasive technology.

Materials and methods. This experimental studies with a simple random design .sample of adult male rats of Wistar strain. The tibia was osteotomy transversely carried at all animals. The treatment group preformed the provision of PEMF stimulation and compare with the control group. Radiographic examination has done in week first, second and fifth. Then, the analysis using a Tiedemann score was performed.

Results. The result showed that effect of the PEMF stimulation on callus formation demonstrated were significantly different ($P<0.05$) on both groups. At the Treatment groups were callus formation in the second week increased two folds, while at the end fifth weeks increased 3 folds compared the control group.

Conclusions. We conclude that PEMF stimulation can be enhancement callus formation.

Keywords: fracture, PEMF, callus formation

Corresponding authors:
Rizmayadi Anwar, MD
Jl. Gunung Bambapuang 2 No. 33, Makassar
HP : 08158809129
Email: ryadianwar@gmail.com

Stimulasi *Pulsed Electromagnetic Field* Fraktur Tertutup Tibia Tikus terhadap Pembentukan Kalus Berdasarkan Pengukuran Radiografi

ABSTRAK

Pendahuluan. Komplikasi *delayed union* dan *nonunion* merupakan masalah yang paling sering didapatkan pada fraktur tulang. Fraktur tibia dengan fibula intak yang mempunyai resiko untuk terjadinya komplikasi *delayed union* dan *non union.* Untuk mencegah komplikasi tersebut telah dilakukan penelitian denganaugmentasi penyembuhan fraktur denganmeningkatkan pembentukan kalus melaluiinternal stimulasi dan eksternal stimulasi. *Pulsed Electromagnetic Field* merupakansuatu eksternal stimulasi yang bersifat *inductive coupling*.

Bahan dan cara kerja. Penelitian eksperimental yang dirancang acak sederhana .melibatkan hewan coba tikus jantan dewasa galur wistar sebanyak 32 yang dibagi dalam 2 kelompok dan telah dilakukan frakturisasi konfigurasi transversal. Pada kelompok perlakuan dilakukan pemberian stimulasi PEMF selama 6 hari dalamwaktu 5 minggu dengan perlakuan 4 jam sehar dan dibandingkan dengan kelompok kontrol. Dilanjutkan pemeriksaan radiografi pada minggu ke-1, ke-2, dan ke-5. Setelah itu dilakukan analisa terhadap hasil radiografi dengan menggunakan skor Tiedemann dalam menilai pembentukan kalus. Analisis dilakukan dengan uji Mann Whitney.

Hasil. Pada hasil penelitian menunjukkan bahwa rerata pengaruh pemberian stimulasi PEMF pada pembentukan kalus terhadap kelompok perlakuan dan kelompok kontrol terjadi perbedaan secara signifikan ($p<0,05$) dari minggu ke-1,ke-2 dan ke-5. Terjadi peningkatan pembentukan kalus pada minggu ke-2 rerata 2 kalinya sedangkan pada minggu ke-5 terjadi peningkatan pembentukan kalus rerata 3kalinya dibandingkan kelompok kontrol.

Simpulan. Kesimpulan yang didapat bahwa PEMF meningkatkan pembentukan kalus berdasarkan penilaian radiografi.

Kata kunci: fraktur, PEMF, pembentukan kalus

Introduction

Every year, there was estimated 6 million people dying of fracture in North America, about 5 – 10% hasdelayed unionor nonunion.Otherwise, in India, from the statistic showed that each year, 16% of 24 million people with fracture hasdelayed union and nonunion. [1]In the year of 2009 the patient who was hospitalized at OOrthopaedicc ward Hasan Sadikin Hospital Bandung as much as10% is long bone fracture with the complication of non union.[2]

Fracture healing is a complex metabolism process which needs interaction of many factors, includewithdrawl of the reparation cells dan gens. If all of its factors is inadequat or if its proccess was broken, the healing will be delayed or interrupted, thus will cause the complication of delayed unionornonunion to the bone.[3-6]The outcome of a complication of fracture such as delayed union and non unionprolong the injured patient to be able to do activities , work or recreation as well as before and it has great impact to the economic of the country and community with the largest productive age group between 20 – 40 years old.Tibial fracture is the most common case for this complication.[7,8]

Based on Wolff's law that "every changes of bone function is followed by certain change in bone's internal and external structure based on mathematical law" which is concluded that bone healing through the osteogenesis, modelling and remodeling because of the mechanical stress. The bone dynamicaly adapted to the mechanic load by it's regular mechanism that quantitatively controls cellular grading and depends on mechanic stimulus.[6,9,10]Fracture healing can be manipulated by external stimulation (biomechanic) and internal stimulation (biology).[3,4,6,10] Biology intervention such as autogen and allogeneic bone graft,a replacement substance for bone graft medicamentous while external stimulus such as mechanical and physical intervention like static and dynamic method for stabilization in operative procedure, and use of noninvasive procedure such as electromag-